REMARKS

Amendment summary

Claims 9 and 15 are amended to recite that the solder bonds an electronic component to a circuit board by means of one or more processes selected from the group consisting of a reflow process, a flow process, a soldering iron, a soldering copper, and flip-chip process. Support for this amendment may be found, e.g., on page 1, lines 20-29; page 3, lines 18-19 and 27-29; page 4, lines 17-22; page 11, line 8; page 12, line 23; page 16, line 23; page 20, line 1; page 25, line 11; and page 26, line 22 of the present specification. Applicant notes that these passages provide proper support for the amendment because they "clearly allow persons of ordinary skill in the art to recognize that [Applicant] invented what is claimed." *In re Gosteli*, 872 F.2d 1008, 1012, 10 USPQ2d 1614, 1618 (Fed. Cir. 1989); MPEP § 2163.02.

Claims 9 and 15 are also amended to recite that the solder has a melting point of 210°C or less. Support for this amendment may be found, e.g., in Figures 1, 2, and 6 of the present specification. In addition, this amendment is supported by page 25, lines 8-13 of the present specification, which recites a normal reflow condition using Sn-Pb; page 24, lines 18-19 of the present specification, which relate to Figure 15(c) showing a cross-sectional SEM photograph taken after soldering; and page 26, lines 8-13 of the present specification which discloses that the copper plate in this Example was kept at a temperature of 210°C to 240°C, then referring to Figure 15(c). These passages support the present amendment because if the melting point of the solder is 210°C or less, the solder will melt in the same manner as a normal reflow condition using Sn-Pb. Further, Applicant notes that in Example 7, the solder was melted under a temperature of 210°C (see, e.g., page 26, lines 8-10 of the present specification).

Claims 9 and 15 are further amended to recite the presence of impurities. Support for this amendment may be found, e.g., on page 28, lines 13-16 of the present specification.

Claims 41 and 42 are canceled because the subject matter of those claims has been incorporated into claims 9 and 15, respectively.

No new matter is added by this Amendment, and Applicants respectfully submit that entry of this Amendment is proper.

Status of the claims

Claims 9-13, 15-20, 33-34, and 41-42 have been rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as allegedly obvious over Blair et al. (U.S. Patent No. 6,109,506) (hereinafter "Blair"). In addition, claims 9-13, 15-36, and 41-42 have been rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as allegedly obvious over Shoji et al. (U.S. Patent Application Publication No. 2006/0071051) (hereinafter "Shoji").

Response to §§ 102/103 rejection based on Blair

Claims 9-13, 15-20, 33-34, and 41-42 have been rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as allegedly obvious over Blair. Applicants respectfully traverse on the basis that (1) the present claims recite that the solder bonds an electronic component to a circuit board, which is not anticipated by or rendered obvious by Blair; and (2) Blair does not disclose or suggest that the melting point of the solder is 210°C or less.

With respect to Blair not anticipating or rendering obvious a solder which bonds an electronic component to a circuit board or the melting point of the presently claimed solder, Applicants respectfully reiterate the arguments previously set forth, in view of the amended claims. Blair discloses a method of enhancing a joint in a metal assembly, where the metal assembly members may be steel, Zn-coated steel, zinc-alloy coated steel, aluminum, and aluminum alloys. Blair only shows its solder being used for these metal combinations. Further differentiating Blair from the presently claimed invention is that Blair discloses wide temperature ranges for a liquidus temperature (from 190°C to 232°C) and a solidus temperature (from 190°C to 450°C), as shown in Table 1 of Example 1 of Blair. Blair illustrates that the melting point of the solder is about 300°C when, for example, the solder includes 40% zinc with the remainder being tin. For this reason, it would not be possible to use such a solder for soldering electronic components and a circuit substrate. On the other hand, the present application discloses a solder which can be used for soldering electronic components and the circuit substrate.

There is also no indication in Blair that the solder therein could be used for soldering electronic components. Blair discloses a welding method in which high temperatures may be applied to the solder materials (because it is steel, Zn-coated steel, zinc-alloy coated steel, aluminum and aluminum alloys which are being welded). Furthermore, Blair discloses that with respect to flux, arc welding and the like may be used to melt the solder material - even when the solder material and the flux are separately provided. This does not disclose or render obvious the presently claimed invention because it does not take into account properties such as printability and preservation time, which must be considered in order to use a solder for electronic components.

For example, with respect to a cream-type solder, or paste-type solder (where solder particles are incorporated and mixed into the flux), since zinc is easily oxidized, an active ingredient in the flux reacts with the solder particles when the amount of zinc is higher than 10% as disclosed by Blair, which is also higher than the composition of the present application. Accordingly, the viscosity of the cream-type solder increases such that it is difficult to print in a short amount of time. Likewise, with respect to a resin flux cored solder, or bar solder, when the solder includes an amount of zinc higher than 10% as disclosed by Blair, the flux reacts with zinc oxide. For this reason, it not possible to use such solder for electronic component materials.

Accordingly, Applicants submit that the presently claimed invention is not anticipated by or rendered obvious by Blair. Applicants therefore respectfully request that the present §§ 102/103 rejection be reconsidered and withdrawn.

Response to §§ 102/103 rejection based on Shoji

Claims 9-13, 15-36, and 41-42 have been rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as allegedly obvious over Shoji. Applicants respectfully traverse.

First, Applicants respectfully submit that the claims have been amended to clarify that the silver presently recited is distinct from the impurities presently recited. Because it has been asserted in the previous Office Action that there would be a motivation to reduce the "Ag impurity" in Shoji, Applicants respectfully submit that the present claims, which clarify that the Ag and the impurities are distinct entities, are not anticipated by or rendered obvious by Shoji.

Applicants also respectfully submit, with respect to the § 103 aspect of the present rejection, that the presently claimed invention possesses unexpectedly superior properties, as

previously noted by Applicants. The Examiner has asserted that Applicants have not shown unexpected results over the prior art. To that end, Applicants respectfully submit that the unexpected results discussed in Mr. Funaya's Declaration (submitted on October 26, 2007) demonstrate the unexpectedly superior results of the presently claimed invention.

Applicants note that it is known that the eutectic composition lowers the melting point, makes alloys finer, and produces favorable effects on the strength. To this end, Fig. 5 in Mr. Funaya's Declaration shows that Applicants found that the densest alloy can be obtained when the content of silver is 0.075 wt% , and did so via experiments in which the added amount of silver in Sn-8 wt.% Zn-1 wt.% Bi-Ag was varied. Thus, Applicants estimated that in the case in which the contents of Sn, Zn, and Bi are Sn-8 wt.% Zn-1 wt.% Bi-Ag, the eutectic point would be obtained in the vicinity of 0.075 wt.% Ag, which is less than 0.1 wt% Ag (i.e., the claimed upper limit of silver). Applicants note that these were reported in a meeting of IMAPS in 2004.

With respect to the prior art, Applicants note that phase diagrams of ternary alloys using commonly employed elements can be found in various publications. In contrast, phase diagrams of quaternary alloys are only rarely found in publications. This is because of the amount of parameters present in such experiments. However, Applicants attach herewith Reference Diagram B, which is an excerpt from the paper "Thenmodynamic database for the Sn-Zn-X based lead-free solder alloy," Kodai Doi et al., Proceedings of Mate 2004, pp. 57-60 which was written by a researcher engaged in study of obtaining phase diagrams by means of calculation and was published after the international filing date (July 1, 2003) of the present application. Reference Diagram B shows a "calculated" phase diagram of Sn-S wt.% Zn-3 wt.% Si-Ag. Although the content of bismuth in Reference Diagram B (3 wt.%) is different from that of Reference Diagram A (1 wt.%), Reference Diagram B demonstrates that the eutectic point of Sn-

8 wt.% Zn-3 wt.% Bi-Ag is obtained in the case of 0.05 wt.% Ag. Thus, Reference Diagram B supports the unexpected results illustrated in Fig. 5 in Mr. Funaya's Declaration.

Accordingly, Applicants submit that the presently claimed invention is not anticipated by or rendered obvious by Shoji. Applicants therefore respectfully request that the present §§ 102/103 rejection be reconsidered and withdrawn.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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